# THE AMERICAN GAS LIGHT JOURNAL

PUBLISHING OFFICE No. 42 PINE STREET

DEVOTED TO THE INTERESTS OF ILLUMINATION, VENTILATION, WATER SUPPLY AND DISTRIBUTION, & GENERAL SCIENCE.

VOLUME XLVII.—No. 12. Whole No. 684. | NEW YORK, FRIDAY, DECEMBER 16, 1887. | $3 PER ANNUM, IN ADVANCE.

A. M. CALLENDER & CO., Proprietors. C. E. SANDERSON, Manager.
JOS. R. THOMAS, C.E., Editor. T. J. CUNNINGHAM, Asst. Editor.

ENTERED AT THE POST OFFICE AT NEW YORK, N. Y. AS SECOND CLASS MATTER.

**Published** on the 2d and 16th of each month, at No. 42 Pine Street, N. Y.

**Terms of Subscription, Including Postage.**—For the United States and Canada, $3 per annum. European countries, $3.50 (15 shillings—18 francs). All payments to be made in advance. Single copies, 15 cents.

**Remittances** should be made either by post-office order, registered letter, or bank draft on New York, payable to the order of A. M. Callender & Co.

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## THE FUEL GAS QUESTION.

Mr. Edwin Squire, writing from Oil City, Pa., under date of Dec. 9, communicates the following in respect of the fuel gas agitation:

To the Editor AMERICAN GAS LIGHT JOURNAL:—May I ask room in your valuable JOURNAL for a few words on the fuel gas question?

Referring to the communication from Mr. Emerson McMillin, which appeared in the JOURNAL for Dec. 2, I must say that some of the reasons therein given why fuel gas should be made are not conclusive. Mr. McMillin says:

"First.—The loss by leakage is a much more serious one with coal gas than with a gas costing less per thousand feet. Second.—The public cannot be induced generally to adopt a high-priced gas for fuel."

Now, if these objections to the use of gas of high calorific value are valid, why not mix 440 feet of coal gas with 560 feet of air to make a gas having about the same heating value per unit volume as the gas proposed by Mr. McMillin? Its cost in the holder would be about $\frac{440 \times 20}{1000}$ = 8.80 cents per thousand cubic feet for the former, as against 9.97 cents per thousand for the latter, the price of coal being $2 per ton.

Probably most gas managers would object to the increased cost of street mains required to distribute the greater volume of gas and air, and the public would be likely to imagine that something was wrong with the meter, or the gas company, when the bills came around, whether the price was 30 or 60 cents per thousand cubic feet.

While it is true, no doubt, that good coal gas, pure and simple, has hitherto been found too expensive for general use as fuel, nevertheless some of the reasons why it should be preferred as fuel to the proposed mixture are:

First.—Less cost per heat unit in the holder.

Second.—Much less size, with consequent lower cost, of distributing mains and holder capacity.

Third.—The same mains could be used for delivering both heating and illuminating—or, in other words, the same gas could be used for both fuel and light.

Fourth.—The large amount (31.18 per cent.) of carbonic oxide in the proposed mixed gas would lead to a well-founded prejudice against its use.

[While we do not at present propose to enter into a critical discussion of the comparative practical value and merit of any of the fuel gases now struggling for recognition as a coign of vantage wherefrom to achieve that solid commercial supremacy resulting from public favor, we nevertheless desire to reaffirm the position steadfastly maintained by us for a number of years. Granting that a cheap fuel gas for domestic use is desirable, if not necessary, the boon when secured must be unalloyed by the excessive presence of an element not only dangerous but deadly. We most heartily agree with Mr. Squire in his surmise that a fuel gas containing 31.18 per cent. of carbonic oxide would be likely to "lead to a well-founded prejudice against its use." Were a gas of the nature proposed intended only for distribution to the firing plant, and in other departments as well, of large factories and workshops, perhaps no grave objection could be made in opposition to such supply, for the circumstances of its application and employment would mainly be governed by and be under the control of persons actively alive to the exigencies of the situation. But when it comes to the laying on to our homes of an unrestricted supply of a like heating medium, which would become at once vastly popular because of its cheapness, utility and convenience, the case assumes a decidedly different phase. The overseer of the kitchen and the furnace differs considerably, in aptitude and resource, from the

trained fireman or mechanic of the factory or workshop. But it is hardly necessary to here enlarge on this feature of the situation. The proof of our position is at hand, but no specific publication of it is deemed necessary by us—at least at the present time, because similar facts may be gathered by those who would care to possess them. Triflers may sneer and sceptics may scoff at what is here said without prejudice or passion, but the cold facts can chill the one and congeal the other. If, then, despite the shields and safeguards (principally instituted through economical motives alone) surrounding the user of gas for illumination, fatalities are of almost daily occurrence, how greatly will the degree of danger be augmented when fuel gas shall have gained ascendency over solid fuel provided the gaseous fuel contains an abnormally high percentage of carbonic oxide? Fuel gas investigators must, as far as possible, avoid all alliance with an ingredient whose greatest potency is in the line of destruction—in the case under consideration it would eventually destroy (at any rate partially) the availability of the product of their investigations.]

## NOT QUITE SO GLITTERING.

Some rather bald facts are reported elsewhere in this issue of the JOURNAL, which have reference to the trials recently made by a committee of experts appointed to determine the cost of lighting or illuminating the structure known as the Grand Central Railway Depot, Cincinnati, Ohio, by gas and by incandescent electric lamps. The results of the trial are not particularly well calculated to give ease to those electricians who are continually and vigorously pointing with pride and speaking with fervor regarding the claims of incandescence illumination in point of the economy and superiority of their pet over gas. On the other hand, the Cincinnati verdict will not disturb other and different apostles of incandescence, their usual quiet being unbroken because of their early and well-formed conviction that, while glow lamps would quite likely find favor with the rich, gas was certain to enjoy a lengthy reign, because it was content to court the favor and patronage of the poor man. If we mistake not no less an agent than Wizard Edison himself is to be credited with the authorship of the rich vs. poor allotment of the possible commercial relations to exist between incandescence lamps and carburetted hydrogen; and, furthermore, Mr. Edison emitted his famous judgment on the question quite a while ago. Knowing all about the matter, as he did, we must pay heed to and give him credit no less for his sharpness than for his candor. In further proof of his convictions on the question—that is, if the talk of the day may be accepted as affording a safe line for analyzing the fact of to-morrow—we believe the Edison Company is about to take a new departure in the process of endeavoring to popularize and localize the Edison system of lighting. It is proposed now, instead of organizing independent local Edison Companies in towns or cities where a gas supply has been laid on, to favor the combination plan; in other words, instead of antagonizing the gas men the Company proposes to sell them Edison plants. In the shout, hurrah, and glitter which accompanied the initial suggestion that gas suppliers generally should also turn current suppliers, it is just possible that too much was taken for granted, especially in connection with lighting by incandescence. The poor man is a much more important specimen in any community than is his luckier brother the rich man, which paradox is readily explained when the greater frequency with which the former type is encountered is remembered. Leaving aside the arc lighting reason why the combination plan should be favorably regarded, and it is seemingly irrefutable that the arc street light is with us for good, it appears to us, and in more pronounced manner than ever, that the fostering by the gas maker of an incandescent electric lighting plant depends solely upon the expediency of such action. We are of the opinion, too, that the inexpedients are in a large majority; and that many now on the fence will find it convenient to remain astride of the timber for a while longer, or else to descend again upon the surface of the pasture which has been green to their eyes for many a day. The Cincinnati trial affords a notable addition to the testimony already given in support of the Edisonian rich vs. poor presentment of the case—and most all artificial light users seem to feel the grind of poverty when it comes to pay the bills incurred in the illumination of their *homes*.

## Briefly Told.

DEATH OF DUNCAN CAMPBELL.—Duncan Campbell, who over a quarter of a century ago entered the service of the Providence (R. I.) Gas Company, died at his residence in that city on the afternoon of December 7th. Deceased, although not connected with the profession in an engineering capacity, was well known to the Eastern fraternity, by whom he was greatly esteemed. In 1861 he entered the offices of the Providence Company to undertake the duties of a subordinate clerk, and so well did he carry out the instructions of his superiors that rapid promotions shortly placed him in the responsible position of chief office clerk. Faithful and responsible, the Company, in his death, loses a valued officer. Deceased was a prominent figure in Rhode Island Masonic circles, and would shortly have completed the 45th year of an exceedingly harmonious and blameless life.

THE GAS WORKS OF BRITISH COLUMBIA.—Through the courtesy of G. L. Milne, M. D., who worthily fills the responsible post of Health Officer for the city of Victoria, British Columbia, we are enabled to present the following notes concerning the gas development in progress in that province. The Doctor says: "The New Westminster Gas Company began operations in that city over a year ago. A large plant was constructed, in fact the work was prosecuted on a scale sufficiently large to provide a supply of gas for a city having twice the present population of New Westminster. The Company has the contract for lighting the streets for the period of 5 years, and the citizens are granting it a hearty patronage. The works cost $75,000, and the net selling price for gas is $3 per thousand cubic feet. Nanaimo, otherwise known as the 'Diamond City' of the Pacific Coast, is now lighted with gas, the Nanaimo Gas Company having commenced operations there towards the close of 1886. Its proprietors have secured great encouragement from the citizens. The works are of the substantial sort and modern in design. This Company is also the possessor of a 5-year contract for the public lighting of the city. The coal carbonized is from the Nanaimo mines, large quantities of which are annually shipped to Oregon, Washington Territory, California, etc. It yields quite a handsome return per ton carbonized. The Vancouver Gas Company's plant has just been completed. Vancouver is the terminus on the Pacific Coast of the Canadian Pacific Railway, and is a remarkably progressive city, considering its age. It now can boast of both gas and electricity for lighting purposes, both systems being granted a healthy patronage. The gas plant just completed is the most perfect one on the Pacific Coast, north of San Francisco, and was put in with the intention of ultimately supplying gas to a large and populous city. Vancouver's advance in trade activity during the year about to terminate is nothing short of remarkable, and the Directors of the Gas Company evidently have ample reason for every confidence in the future of Vancouver. The works cost in the neighborhood of $100,000. The net selling rate to ordinary consumers is $3 per thousand cubic feet.

PUBLIC LIGHTING, PLAINFIELD, N. J.—The Plainfield authorities have awarded a contract for the public lighting to the Westinghouse Electric Company, the same to run for one year. The Company is to supply incandescent lamps—arc lights were formerly used, but on account of the great number of shade trees the illumination was very imperfect—to be mounted on poles 10 feet in height, lights to burn all night and every night. The price agreed upon was $14.60 per lamp in what is known as the gas district; for 1,000 feet outside that district the service is to cost $17.50 per lamp; while outside the 1,000-feet limit a "special rate" is to be charged. The Gas Company did not make any bid. For the North Plainfield district the contract was given to the New York and New Jersey Globe Lighting Company, whose owners are to receive $17.75 per lamp (naphtha), on a lighting schedule of 22 nights each month. The contractors are to light, extinguish and clean. North Plainfield (population about 2,500), and Plainfield (population about 13,000), really form one city, Green Brook being the separating line. The places, however, are in different counties.

COST OF A DAY'S FOG TO LONDONERS.—The *Metropolitan*, speaking of the dark days that happened in London towards the close of the last month, says: "Wednesday (November 26), last week, was a day of continuous fog, necessitating the extensive use of gas, and on that day the quantity of gas supplied to London by the Gas Light and Coke Company amounted to 103,664,000 cubic feet, or 35,000,000 cubic feet in excess of the quantity sent out by the same Company in the corresponding day of last year. The above excess in the supply of gas would represent the supply to a town of from 10,000 to 12,000 inhabitants for a whole year. In addition to the quantity supplied by the Company mentioned, there was supplied by the other two metropolitan companies—the South Metropolitan and Commercial—about 45,000,000 cubic feet, making a total consumption for London, on a day of fog, of nearly 150,000,000 cubic feet. Approximately the value of this gas was £21,000, of which cost from £7,000 to £8,000 was directly due to the fog. In 1885, on a day of similar fog, a great strain was put upon the companies, but it is said that the supply on Wednesday last week beats the previous highest record."

## A Regenerator Tar Furnace.

By J. Somerville.

[At the last Quarterly Meeting of the Southern District Association of Gas Engineers and Managers, held in London, Eng., on Thursday, Nov. 10, Mr. J. Somerville read the following paper. Our authority is the London *Journal*.]

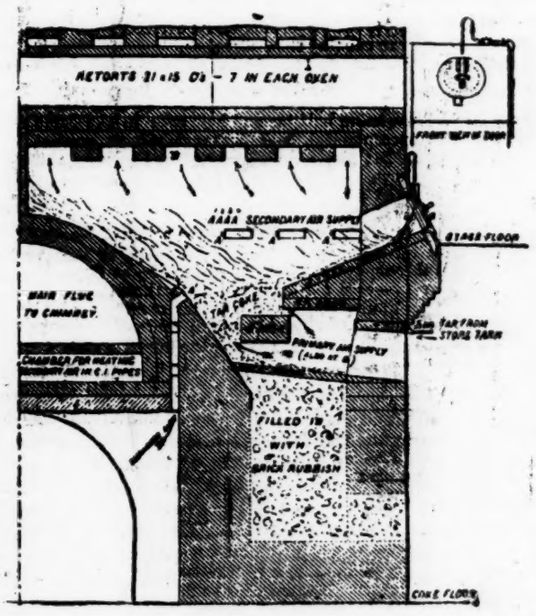
Within the past two years there have been described and illustrated several furnaces for, and methods of, burning tar as fuel under the retorts instead of coke; and it would seem scarcely possible to have anything new to say upon the subject. As, however, our Secretary had some difficulty in obtaining a paper for this meeting, I have taken the opportunity to describe to you the arrangement for burning tar in use at the Bankside Gas Works. Probably it may be new to some of the members, and perhaps not without a certain amount of general interest just now, when tar is still a drug in the market and so low in price. I do not propose to enter into the question as to whether it is right or wrong to burn tar, as it would make this paper too long; but you may endeavor to settle that question during the discussion which I trust will ensue, as there are some of our members who hold different views on the question, and may have something to say for and against it. I will content myself by simply describing the arrangement of furnace which has been found best suited for the complete combustion of the tar, and by giving you the results of my experience of its working.

I may say that for the last seven years all the furnaces at Bankside have been of the regenerator principle; and at first a little difficulty was presented in adapting them to the burning of tar instead of hot coke drawn direct from the retorts into them, as formerly was the case. Several modifications were tried—such as using half breeze and half tar, blowing the tar into the furnace in a spray with a jet of steam, and then steam and air combined, which cut the sides and back of the furnace very much; but perhaps the greatest trouble was to get a constant, regular flow of tar without requiring much attention. Many plans and arrangements were tried and given up—some of them bad, others indifferent, and none very good; but, by keeping on trying and failing, we have at last arrived at the furnace a drawing of which you see before you, and which has now been in use for eight or nine months. Although this may not be quite perfect, it gives satisfaction; and a great consideration is that the stokers like it, and have no fault to find with it—resulting in less bad language being used about tar fires than was the case twelve months ago. Besides, we have good heats, absence of smoke, and no clinkering.

You will observe that the lower part of the regenerating furnace has been filled up about half way. An arch is thrown over from side to side, on which is formed a slope from back to front of the furnace, for the coke made by the combustion of the tar to fall down. At 6 inches from the back a 14-inch arch is built; and 1½ inches above it is a 4½-inch arch carrying the tiles sloping upward to the front, and projecting some 9 inches beyond the front line of brickwork of the benches; the brickwork being corbeled outward to support the sloping furnace door and frame. The incline of the tiles is about 15 to 18 inches in 4 ft. 6 in., or about an angle of 22°. This is found to be about the right angle to set the tiles at to receive the tar, and for the tar coke formed to find its way to the lower openings where it is consumed by the two currents of heated air getting access to it through the space between the arches and the back of the furnace. As the coke produced by the tar is nearly all carbon, and (unlike coke made from coal) contains no earthy residue or ash, etc., no clinker is formed, and only hot waste dust finds its way through the openings on to the slope, and thence to the floor of the coke-hole.

The tar is passed through the furnace door direct on to the sloping tiles. A slot or opening, equal to 8 square inches in area, in the door admits sufficient air for the primary combustion of the tar; and as it inflames before it reaches the tiles, the draught carries the flame into the body of the furnace, where it meets and joins with the secondary air which enters through the nostrils in the sides and back of the furnace. This secondary air is heated in cast iron regenerating tubes laid in the bottom of the main flue beneath the retort benches. This heat, and also that from the combustion of the tar coke which is constantly forming, and as constantly being consumed at the lower level of the furnace, passes up through and among the retorts in the ordinary way to the main flue. This admission of hot secondary air greatly aids the complete combustion of the tar, and prevents the formation of smoke; so that there is little or no flame among the retorts. As the tar flows in a constant, well-regulated stream, and the coke as it is made falls down the slope to be consumed at the lower openings, and the hot dust drops out through these openings on to the bottom slope, and from there to the floor, the whole process is nearly automatic, and needs very little attention.

The tar is run into the furnace in the manner illustrated in the drawing. The store tank is situated outside the retort house, some 15 feet away. A pipe conveys the tar under the stage floor; and opposite each furnace is a smaller pipe, which takes the tar to the door, terminating in a stopcock and ½-inch bend. On the end of the bend is a plain socket, plugged with a piece of wood having a smooth hole bored through it to receive a ⅜-inch brass tube, to which is soldered about a foot of ¼-inch brass tube bent in the form shown—a sort of half hoop. We find this bent tube answers better than if it was straight. The end of the tube comes to within an inch or so of the opening in the door of the furnace; so that the foreman or attendant can see as he passes that the tar is running properly. The tap is turned full on, and the tar delivered by the ¼-inch tube keeps the furnace going with a very intense heat without interruption. The tar is not filtered in any way. At first it was filtered by gauze screens and perforated zinc plates in a box; but this was a constant source of annoyance and trouble, and was given up, as we found it was unnecessary, and the tar is now allowed to come direct from the tank, having about 8 or 10 feet head. In cold weather the pipe is covered with sawdust, and a steam pipe laid alongside it from the tank to the retort house keeps the tar thin. In this manner we use up the whole of our tar, and have not sold any for a long period.




I have from time to time measured, estimated, and compared the quantity of tar used in these furnaces with the coke formerly consumed in them; and I find it generally works out to something like 24 gallons of tar per ton of coals carbonized—being about equal to 245 lbs. of tar. The coke previously used was 2½ cwt., or 280 lbs., for the regenerating furnaces. As we sell coke at 8d. per cwt., and tar at ½d. per gallon, the saving in our case is about 8d. per ton of coals carbonized. But the benefit is greater to those who use the common furnace, as they usually consume about 3½ cwt., or 392 lbs., of coke per ton, as compared with 245 lbs. of tar, or a saving in favor of tar of 1.4d per ton of coals, where only ½d. per gallon can be obtained for the tar. Each bench of seven retorts carbonizes about 7 tons 10 cwt. of coals per 24 hours; and about 180 gallons of tar is consumed in the two furnaces, at the rate of rather more than 3½ gallons per hour per furnace.

It has been stated, and some people still believe it, that by using tar as fuel the value of it is not raised. Let us see. In one bench of seven retorts, heated by tar as stated, 7 tons 10 cwt. of coals are carbonized every 24 hours. The quantity of coke not used for fuel is 2½ cwt. per ton of coals carbonized, equal to 20 cwt. for the 7 tons 10 cwt. of coals; and this is sold at 8d. per cwt., equal to 13s. 4d. money value. We use 180 gallons of tar as fuel instead, which, at ½d. per gallon, amounts to 7s. 6d. —being a saving in every bench so heated per 24 hours of 5s. 10d.; or, dividing the 13s. 4d. by 180 gallons, the value is raised from 0.5d. to 0.88d. In common furnaces (non-regenerators) 3½ cwt., or about 25 per cent., of the coke made would be saved; being equal to 26 cwt. per bench. This at 8d. per cwt. would realize 17s. 4d.; showing a saving in every bench of 9s 10d. per day, and raising the value of the 180 gallons of tar from 0.5d. to 1.15d. per gallon. Surely, when coke is in good de-

mand and tar a drug at any gas works, it must be economy to burn the tar under the retorts and sell the coke thus saved.

These furnaces being on the regenerating principle, and so already provided with a secondary air supply, and situated in a stage retort house, it may be said that the arrangement could hardly be adopted for common furnaces in ground-floor retort houses. But by deepening the ashpit about 9 or 12 inches, occasionally removing the dust made from the tar coke with a pan-shovel, and laying on the furnace bars fire-tiles sloping toward the back, and getting a secondary air supply from the ashpit by recesses made in the sides and back of the furnace to nostrils 12 inches or so above the slope, this would overcome the difficulty of adapting them to existing retort benches.

The secondary air supply I consider very necessary and essential for the complete combustion of the tar, which is then consumed without the production of smoke. By employing only half measures—such as using half tar and half coke in the same furnace—it is not economical, and does not always prevent the formation of smoke; and it seems very much like burning tar to get rid of it anyhow. But when tar has to be used as fuel, it may as well be consumed properly, with some regard to economy, and without producing thick clouds of smoke.

I said I would not say anything about the policy of burning tar as fuel; but I can scarcely conclude this brief paper without remarking that there may be two ways of looking at the question. And I confess I have some sympathy with those who take the sentimental view of the matter; for it does seem a great shame that in this latter part of the nineteenth century we should be compelled to utterly destroy the source of so much that is beautiful, useful, and ornamental, and which has been the very *El Dorado* of chemists both at home and abroad for the last quarter of a century, and a waste material upon which has been lavished more thought, pains, and experiment, by men of great genius, than upon any other waste product one can mention. It is the raw material also from which is manufactured the thousand and one articles you have seen enumerated on those wonderful tar trees, especially the last issued by Mr. Benjamin Nickels, F.C.S., graphically colored with all the hues of the rainbow, representing the beautiful products obtained from the common black tar, and tabulated with such fearful-looking names—regular tongue-twisters—any one of which would puzzle a Welshman to pronounce without stopping to take breath. I say it does seem a pity that this valuable commodity should be put to so base a use; but then comes the other view of the matter—the commercial aspect of the question. If all further invention is hopeless, if all genius in regard to finding out other rarities and novelties is lying dormant for a season, and no Samson arises to the occasion and gives us deliverance—and there never was a finer opening or better opportunity for the rising chemist or man of science to show the way out of the difficulty—till this is done, and a better use can be pointed out, I am afraid that we must continue to burn it. What, for instance, is to be done in the following case: The manager of a good-sized country gas works, which are situated n the center of the country away from any water transit, has eight or ten benches of retorts, and he has to cart his tar to the railway station, and there pump it into tank trucks to go some 30 or 40 miles to the tar distillery. He came to see me at Bankside some months ago, to learn how we burned our tar. He told me that the contractor absolutely refused to take his tar, and would not renew the contract at any price, as the cost of railway carriage was double the value of the tar. As he had a good sale for all his coke at a fair price, he asked me what was best for him to do. Now what was that man to do with his tar? I told him he had done the best thing he could under the circumstances, and that the way in which it could be best utilized in the retort furnaces was as he saw it before him; and I advised him to go home and do likewise, which he did.

[Mr. Somerville added that since he wrote his paper, about three weeks ago, a paper* had appeared by Mr. C. H. Nettleton, of Birmingham, U. S. A. It was a very able contribution to the subject of gas works residuals, and well worth reading. It appeared that in America they obtained $2.50 per barrel for their tar, each barrel holding about 50 gallons. This worked out to about 2d. per gallon. In conclusion Mr. Somerville quoted the last paragraph of the section of Mr. Nettleton's paper in which he dealt with the subject of "tar."]

*Discussion.*

The President said that Mr. Somerville had put before the members some useful suggestions as to burning tar, which might be adopted by those who were in charge of works sufficiently large to allow of regenerator furnaces being used. This was a condition of things under which he (the President) had not been able to work at present, as his place was very small. He had tried to use tar, and was successful as far as actually burning it went—regulating the supply to the furnaces, and getting good combustion; but he did not obtain such good heats as he had previously done with coke fires. He hoped in the discussion they might be able to add something to their knowledge on this matter, because there was not the slightest doubt that they would be compelled to go on using tar in this way for some considerable time to come. At his works they could only dispose of the tar in small quantities, for paving and other minor purposes. The tar distillers were too far away to make it worth while for him to send the tar to them, because by the time they had deposited it at the distillery it hardly returned them anything. Under the circumstances, all he could do was to give his attention to the proper and best means of utilizing it as fuel.

Mr. C. Gandon (Lower Sydenham) remarked that he did not think he could add very much to what Mr. Somerville stated in his paper, except that he might say he had had considerable experience in burning tar. In October, last year, he began to use tar on the works of which he was at present in charge; and in doing so was helped by his former experience of it. The conclusion at which he had arrived was that to burn tar successfully—he was not referring to regenerator, but to ordinary furnaces—it was necessary to have a large combustion chamber; in fact, a bench of seven retorts, with the central one over the furnace arch, was an unsuitable erection for burning tar properly. He illustrated this last summer by using tar in a furnace with seven retorts, and he very soon succeeded in burning out the middle retort. They then started twelve furnaces, heating six retorts in each, the middle retort being left out. They thereby obtained a large combustion chamber. These were in operation, he remembered, from October last year until June this year without intermission, and they worked very satisfactorily. The reason they were stopped was because they needed some repairs. They found that the retorts were very little damaged indeed. One or two of the arches—they were Gothic arches—had burnt down; the other ones being as good as when they first started. He could entirely confirm Mr. Somerville's statement as to there being a very small amount of clinker formed. Very little clinkering required to be done in the furnaces, and therefore the sides were not so likely to be destroyed as they were when burning coke. As he had said, they had only used ordinary urnaces at his works; and they had a very simple way of introducing the tar into them. They had a tank in the coal store adjoining the retort house, and the tar ran from it by pipes to the latter. On the pipe supplying each furnace they had a tap, on which was a cock, with a small piece of twig passing up, which was pushed up now and then to keep the tar running. The only difficulty they found was that the men would not look after the fires sufficiently well to prevent smoke occasionally issuing from the chimney. He should be glad if Mr. Somerville or anyone else would tell them how to make it impossible for smoke to come out of the chimney. His experience was that they used about 100 gallons of tar per furnace per 24 hours; and he understood Mr. Somerville that he burned 90 gallons; so they did not differ very much. As they could only obtain ¾d. per gallon for the tar, he considered it best to burn it; but he should be pleased to be able to get such a price for it as would render it unnecessary to do so. So long as a sufficient price could not be obtained for the tar, he should, notwithstanding the beautiful colors to which Mr. Somerville had alluded, advise gas managers to burn it. He should like to ask the author of the paper whether he had not rather over-estimated the relative value of tar, when he took the value of coke at 8d. per cwt. at Bankside.

Mr. F. Livesey observed that he was unfortunately absent when Mr. Somerville read his paper; but he had had some conversation with him as to the origin of this furnace, and he (Mr. Livesey) would like to explain it. The Rotherhithe works of the South Metropolitan Gas Company were managed at one time by the late Mr. Croll, and Mr. G. Anderson was there. The latter gentleman, he believed, left in charge of a bricklayer—a very old man now—a drawing of a furnace. It was true that this furnace was not adapted for a stage retort house; but it was a furnace that had a slot in it, and an inclined slope on which the tar was spurted, and air was admitted at the back. This was the main principle of the furnace which Mr. Somerville had described. There was a difficulty in a floor house to probe away the dust from the back of the furnace. On seeing the drawing he referred to, he had the furnace tried at Rotherhithe; but it did not succeed. They made another trial at the Old Kent Road; and there it answered very well—indeed, so much so that he mentioned it to all their managers, and suggessted that they should try it at the different works. Mr. Somerville had this advantage—that he had secondary air admitted to his furnace, which was just the thing required to make it a complete success. In burning tar there was a great deal of difficulty in keeping down the smoke.

*See JOURNAL, Nov. 2, 1887, p. 279.

There was a sort of pitchy mass accumulated where the tar dropped. A man would go in with a rake or other tool and stir it up, and then they had a tremendous volume of smoke from the chimney. By admitting the secondary air, however, this difficulty was entirely surmounted; and with proper management there need never be any smoke at all. It was not necessary to have any elaborate system of heating the air, and it was very certain that all they required was an air supply on the top of the fuel. It was important that the combustion of the tar should take place not immediately between the two bottom retorts, but, if possible, lower down, as might be managed in a stage retort house. The only place where this furnace burnt away was at the back, where the air was admitted. This need not occur if it was always kept full of its tar fuel. The proper way to burn tar was to use tar only, and then they could very readily find out what they were doing. When tar and coke were consumed together, they were absolutely in the dark as to what they were about. When tar was employed alone, they had only to measure it day by day to ascertain precisely how they stood; they knew the price of the tar and the value of the coke. With respect to the flowing of the tar, Mr. Somerville introduced a very great improvement in the furnace. By the means he adopted he allowed the tar to flow from his pipes direct into the furnace on to the fuel. The best way to regulate tar was to have a long tube, or a spiral tube, which could be easily taken in and out, and was very little trouble indeed. The tar would never stop flowing if it was properly strained. He (Mr. Livesey) rather liked the bent tube. He preferred the bent tube coming out of a T, for if there was anything in the tar it collected in the bottom part of the T. He thought Mr. Somerville had worked very hard at this furnace, and had certainly improved it; but he should like it placed on record that something was due to Mr. Anderson, as it was first brought out by him.

Mr. C. C. Carpenter observed, as the result of his experience with various forms of tar furnaces, that it was very necessary to have a secondary air supply to the furnace, and equally necessary that it should be heated; but to do this effectually did not demand an arrangement of properly-constructed air-heating flues, where these did not already exist. They had at the Vauxhall Gas Works twelve tar furnaces applied to the ordinary settings, constructed with a front chamber similar to those described in his (Mr. Carpenter's) paper read before the Association last year. Through this chamber a 3-inch pipe was built conveying air, which thus became heated in its passage into the combustion chamber of the furnace. This arrangement almost wholly prevented the formation of smoke, which it was not possible to do when cold air was admitted at the furnace door. With reference to the regulation of the flow of tar, they used the straight brass tubes as described by Mr. Frank Livesey, and nothing could exceed the simplicity of the arrangement, nor the perfect control it permitted over the supply to the furnace without the slightest attention.

Mr. W. H. Broadberry (Tottenham) said the furnace he used was very much like the one which had been described. They had no iron chute at all, but simply ran the tar direct upon the fuel. He had some difficulty in having a very small combustion chamber; and he found it almost impossible to get rid of the smoke. While he was personally in the retort house they could manage to get along very well without much smoke; but when he left it in the hands of the stokers a large volume of smoke was soon seen issuing from the chimney. Stokers seemed to have the idea that the furnaces were erected purposely for consuming tar; and as long as they got as large a quantity of tar into the furnace as was possible, they considered they were doing as much as could be expected of them. With his setting of eight retorts he was burning about 5 gallons of tar per hour; and comparing the cost of tar and coke he found that the tar at ¾d. per gallon about equaled coke at 6d. He must confirm what had been said as to the condition of the furnaces in which tar was used. When he let down the furnaces at his works they were in almost as good a state as when they lit them up. As to cost, he could not at all compare with Mr. Somerville's figures; but next winter he might be able to do better.

Mr. D. Ford Goddard (Ipswich) said there could be no doubt that the burning of tar had gone far beyond the mere experimental stage. That it could be burnt had now been proved again and again; but whether it could be done to show real economy was quite another matter altogether. History said that at Ipswich, many years ago, there were built several of Mr. Anderson's tar furnaces; and history also recorded the efficiency of these furnaces—at least as regards heat, because he understood that the retort setting came down upon the top of the furnace as the result of the enormously high temperature. Now, with the experience he had had with burning tar, he certainly could not complain of want of heat, although he had never had the opportunity of using regenerator furnaces. He had simply had ordinary furnaces with the middle retort left out—six retorts in a bed—which gave considerable capacity for a combustion chamber. He had no difficulty in getting sufficient heat; the trouble was to regulate it. When he began to burn tar (he thought it was last year) the calculation he made was that if they could not sell tar for 1d. per gallon it would answer their purpose to burn it. But subsequent calculations, based upon real working of the furnaces, showed that this was too high a figure; and he immediately came to the conclusion that if they could get ¾d. per gallon it was better to sell than to burn it. With regard to smoke, he said he could not conceive of any method of burning tar in which they could completely do away with the smoke nuisance. Whether or not this was a nuisance that stood in the way of the utilization of liquid fuel, he was not prepared to say. There was no doubt that the use of tar caused considerable inconvenience, and entailed trouble in watching—seeing that the furnaces did not become too highly heated, and that there was no destruction going on in the furnace. The inconvenience of having constantly to watch was, he supposed, really the reason why it was becoming the prevalent habit to do away with tar burning.

Mr. J. L. Chapman (Harrow) remarked that the question of tar firing was one of considerable interest. He had tried it and had found the same results as many others—that the retorts were destroyed in the furnace. They had splendid heats, and obtained higher results per mouthpiece than they ever had before, and a better return per ton of coal carbonized. But afterwards they found that the bottom retorts and the middle one were very much shaken, and pieces were constantly dropping out. The heat was sometimes so great that the retorts would run and stop the flues; and in the case of one bench especially, they were not able to use the retorts again. This tar question was one of great difficulty for small gas works. In such works a man would come and pump up the tar and take it away; and they were very glad indeed to see the back of him and get the tar out of the works. When they had always before them this constant tar pumping, with more or less muck connected with it, he thought that many of them, for the sake of a shilling or so, would rather see the back of it. He (Mr. Chapman) was in a position that made it absolutely necessary to burn his tar. He was two miles from water carriage, and ten or eleven miles from London; and therefore he was compelled to utilize it. In the course of a conversation on the subject with a gentleman he mentioned that he had seen a tar injector in Vienna, the invention of Mr. Drory, which might be of service to him (Mr. Chapman). He procured one and applied it to the boilers, and he must say he was extremely satisfied with the result, both from a monetary point of view, and as requiring less attention than anything he had tried before. It was a peculiar thing that as soon as they commenced burning tar their coke began to accumulate, and it had gone down in price something like 3s. or 4s. per chaldron.

Mr. P. Thomas (Ware) said he would like to give the meeting his simple experience of tar firing at a country gas works. He had adopted this plan of heating his furnaces; but was working under difficulties. He would rather that his middle retort would burn away, and then he would have a larger combustion chamber, which would prevent the smoke. The result was that he had to use a portion of coke to avoid this. He had a regulator by which he could pass the required amount of tar into the furnace. He burned a little more than a gallon per hour; and in a setting of seven retorts he used 3 cwt. of coke. There was sometimes a complaint of smoke; but he could see this from his own house, and could have it altered directly, and it caused no trouble at all to do this. The arrangement he employed was very simple, and he was able to get a yield of 10,000 cubic feet of gas from a ton of East Pontop coal, which he thought was practical working. He mentioned that he obtained 8d. per cwt. for his coke.

The President said he was pleased to find, from the discussion, that so many gentlemen had been successful in the matter of tar firing. They had had various appliances described, and most of the members had spoken of having obtained good heats; but he (the President) had not yet learned how this was accomplished. As this was his one trouble, he would briefly describe the setting he used; and if Mr. Somerville, in the course of his reply, could help him out of his difficulty he should be glad. He commenced by using tar with a sort of intermittent coke fire. He could not get on with the system, and so gave it up, and adopted a style of furnace exactly similar to that shown in the drawing which Mr. Somerville had exhibited, with the exception that the air was not heated, but simply drawn in at the back of the furnace, and a slight portion at the very front where the tar was admitted. He had the same style of tar regulator, and tiles on which the tar trickled down; and he could regulate the tar exactly as it was wanted. His retorts were 15-inch circulars, and the bed was 6 ft. 6 in. wide and 4 ft. 6 in. high. He could not obtain with tar such good heats as he formerly did with coke.

Mr. Somerville, replying on the discussion, said he was much obliged for the criticism of his paper. As to Mr. Gandon's remark about the figure he quoted for coke, 8d. was the price in the yard at the time he wrote the paper. With respect to Mr. Livesey's observations as to the originator of the furnace, there was no doubt that Mr. Anderson did make a very good furnace years ago; but there was no reason why it should not be improved upon. Although there was a sloping tile, etc., the furnace he had described was essentially different from Mr. Anderson's. Anyone who came to look at his drawing and then at Mr. Anderson's would see that there was not the slightest resemblance. He did not wish to take away from Mr. Anderson or any other inventor what was due to him; and he believed that Mr. Anderson's method was one of the best. This was the arrangement with which they commenced; and, in the course of working, one thing suggested another. The main feature of the furnace he had described was the secondary air supply, which effected the complete combustion of the tar. This was the whole secret of the furnace that he had described in the paper. [Mr. Somerville explained, by the aid of the diagram, the course of the secondary air supply.] Since first started the furnaces had been lowered 18 inches, as he found they burned the edges of the retorts. If they had 3 ft. 6 in. in the depth of the furnace they would not have any intense heat in the bottom retort. They now had a regular heat all through, without any detriment to the middle retort. With Mr. Livesey's other remarks about using half tar and half coke, he quite agreed; it was impossible to know what one was doing when half one and half the other fuel was employed. He formerly used, as Mr. Livesey had described it, a T; but it was Mr. Geo. Livesey who made the suggestion to do away with it. He explained its object to him, but he could not quite see it; and so he (Mr. Somerville) tried the bend. Therefore this was Mr. George Livesey's part of the arrangement; and this was the reason for the departure from the T. He thought he had answered Mr. Goddard about lowering the source of heat just about a foot, so as to get 3 ft. 6 in., which would protect the retorts from injury. Mr. Thomas was doing very well—rather better, in fact, than most managers. He had, however, the same trouble with smoke, and he could only prevent it by introducing secondary air. This, as he had said, was the secret of thorough combustion. As to their President's inquiry, he (Mr. Somerville) would suggest that the way to overcome his difficulty would be to make three recesses of 2½ by 9 inches in each side of his furnace, and then he would be certain to get thorough combustion.

## The Effect of Freezing on Cement-Mortar.

Something over a year ago Alfred Noble, C.E., read a paper on this subject before the American Society of Civil Engineers. The author said:

In the construction of a lock at the St. Mary's Falls Canal, the laying of masonry was discontinued about Oct. 20 of each year on account of the frequent recurrence of freezing weather. On the last day of the work in 1887, mortars of Portland cement and of a good quality of American natural cement were used in adjoining portions of the wall. The same proportions of cement and sand, 1 to 1, were used in both classes of mortar. This masonry was laid during a light rain. The following spring the surface of the Portland cement-mortar was sound, showing perfectly the marks of the rain drops. The natural cement-mortar was disintegrated to a depth of 3 or 4 inches.

In the same locality it was necessary to lay a concrete foundation for a movable dam in February. The weather was extremely cold, generally about zero. The mortar was made with Portland cement. Salt was used freely, but without retarding very much the freezing of the concrete. The concrete was at once covered with a floor of timber and plank, on which the masonry abutments were built. Samples of the frozen mortar set properly after being put in a warm place. There was never any settlement of the masonry, and within a few months the concrete sustained a pressure of 15 feet of water without developing any leaks.

In the construction of a bridge across the Clark's Fork of the Columbia river, in Northwestern Montana, the caissons were filled with concrete during freezing weather. Portland cement was used. The proportions of cement to sand were 1 to 3. Within a week the laying of stone masonry was commenced on these caissons, and proceeded with as rapidly as possible without apparent injury to the concrete, which had set firmly. In these cases the temperature had risen above the freezing point within two or three days after the concrete had been placed; and it had been permeated to some extent by warm air escaping through leaks from the air chamber.

Four small piers were built for the St. Louis River Bridge on the Northern Pacific Railroad, near Duluth, in the winter of 1884–5. During the laying of masonry for pier 1 the temperature varied from 0° to 20°; during the building of pier 2 the temperature was about 20° higher, and during the building of the remaining piers the temperature was occasionally about the freezing point. Portland cement was used throughout, the proportions of cement and sand being 1 to 1½ for face stone, and 1 to 2½ for backing. During the extremely cold weather salt was used freely in the mortar, and the sand was warmed (not made hot); but with the thermometer at 20° the mortar froze quickly after being spread on the stone—so quickly, indeed, that if the stone, being set, could not be brought to a bearing by a little shaking, it was necessary to raise the stone, scrape off the now frozen mortar, and spread a new bed. In setting the face stone the mortar was kept back from the face an inch or so to facilitate subsequent pointing. A few weeks later, after there had been milder weather, an examination of the open edges of the mortar beds showed that the mortar used during the coldest weather had set firmly, and no difference could be detected by examination of detached fragments between the mortars in piers 1 and 4; that is to say, between that laid in the coldest and that laid in the mildest weather embraced in the period of construction of these piers.

During the course of tests of cement at the St. Mary's Falls Canal, a few experiments were make relating to the effect of freezing and the use of salt on cement-mortars. They are not submitted as conclusive in any way, but as suggestive, and in the hope that, combined with others, some definite conclusion may be reached.

TABLE A.—EFFECT OF FREEZING ON MORTARS OF PORTLAND CEMENT CONTAINING VARYING AMOUNTS OF SALT.

*Composition of Mortar.*

Cement ..... 35 ounces.
Water ..... 7 "
Salt as in table.

*Tensile Strength per Square Inch at Seven Days.*

| Treatment. | Salt. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 0. | ⅛ oz. | ¼ oz. | ⅜ oz. | ½ oz. | ⅝ oz. | ¾ oz. | ⅞ oz. | 1 oz. |
| *First Series.* | | | | | | | | | |
| Immersed in test-room when removed from moulds | 327 | 357 | 375 | 392 | 429 | 402 | 415 | 388 | 402 |
| Exposed to air when removed from moulds and frozen 3 days; then immersed in test-room 4 days | 316 | 378 | 411 | 374 | 415 | 405 | 392 | 383 | 409 |
| *Second Series.* | | | | | | | | | |
| Immersed in test-room when removed from moulds | 336 | 422 | 421 | 399 | 394 | 384 | 390 | 356 | 387 |
| Exposed to air when removed from moulds and frozen 6 days; then exposed to air in test-room at 70° one day | 169 | 198 | 167 | 217 | 227 | 215 | 208 | 221 | 239 |

TABLE B.—EFFECT OF MIXING SALT WITH PORTLAND CEMENT MORTAR.

*Proportions by Measure.*

Cement ..... 1
Sand ..... 1

*Proportions by Weight.*

Cement ..... 21 ounces.
Salt ..... 23 "
Water ..... 6 "
Salt as in table.

*Means of Ten Tests.*

| Salt. | Tensile Strength, Pounds per Square Inch. | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 7 days. | 30 days | 90 days | 6 mos. | 9 mos. | 12 mos. | 18 mos. | 24 mos. |
| 0 ..... | 155 | 220 | 289 | 311 | 390 | 382 | 402 | 430 |
| ⅛ ounce ..... | 139 | 200 | 246 | 288 | 363 | 364 | 423 | 346 |
| ¼ " ..... | 139 | 192 | 221 | 289 | 352 | 383 | 392 | 326 |
| 1 " ..... | 128 | 189 | 217 | 288 | 343 | 369 | 350 | 334 |

The following discussion ensued:

F. Collingwood—Mr. Noble said that he found the natural cements did not stand the cold so well as the artificial cements; that he always found

the natural cements to be damaged two or three or four inches from the face of the joints after they had been exposed to very severe freezing, and we found something of the same kind in our work on the East River Bridge. On any wide wall where water could collect on top and where it was exposed to the weather all through the winter, we found that we would have to scrape out the joints; but the face joints never troubled us. We used the Rosendale cements.

George S. Morison—As bearing immediately upon the subject of freezing, I might mention an incidental experiment that occurred last winter in the work on the Omaha Bridge. I had quite a number of briquettes made of American cements and imported Portland cements, which were exposed to the air 24 hours and then left in the customary way in a pail of water. There came on extremely cold weather, and the entire lot became a solid block of ice. When it thawed out the Portland cements were entirely uninjured, but the American cements were entirely ruined, some of them being reduced to mud. Subsequent experiments showed that the cements which stood freezing three days after they were made, would also stand freezing immediately after they were mixed. It has been for some years my practice to use Portland cement exclusively in places where the mortar was likely to freeze before setting.

Bobert B. Stanton.—I have had some experience in laying masonry in very cold weather. In the winter of 1878 and 1879 it was found that a small pier on the Cincinnati Southern Railway was defective. The pier was taken down and rebuilt with Louisville cement, and with the use of salt. The thermometer at the time ranged from 6° to 10° below zero. The iron trestle was put upon the pier, and during the winter no change in the masonry was noticed. When, during the next summer, it became very hot, the pier seemed to sweat; the salt came out and made the sides white, but the cement was as hard as if it had been laid in the summer, and, so far as I have since learned, there has never been any trouble with that pier. In the winter of 1881, here in Denver, in building the round-house and shops of the Union Pacific yards it became cold very suddenly. After waiting for awhile, the weather not getting more moderate, the work was proceeded with and salt was used in lime-mortar, and every night the top was covered with a thick coat of salt; the mortar was not really frozen. The next summer a locomotive got away and struck this masonry between the two windows, tearing away the lower portion and leaving the whole keystone portion above suspended and held up by the mortar; and this masonry hung thus for several weeks. It is possible that the mortar did not freeze during the day, but during the night the temperature was very low.

Eliot C. Clarke—Some years ago I made a number of experimental batches of concrete, some of Rosendale cement and some of Portland cement. Of these a portion were made with a large proportion of cement, and some weaker, of each kind. I made them just before freezing weather and left them out, being engaged on work in which some concrete had to be exposed in that way. They were left for two or three years exposed, and during the first winter the Rosendale concretes without exception began to weather badly on the surface, and from year to year disintegrated; none of the Portland cement concretes were affected at all in three years, though lying right on the surface of the ground in blocks about a foot square. I remember once talking with Mr. Shanahan, who is the Superintendent of Public Works of the State of New York, about his practice on the Erie Canal, and he told me that he would as willingly build masonry in the winter as in the summer, so far as its durability was concerned. He used Rosendale cement in building masonry, a tolerably strong mortar—that is, a large proportion of cement to the sand; and always used in mixing only the strongest brine—that is, water saturated with salt so that it would foam on top. He said he never knew a case to fail built in that way.

John Bogart—I have had occasion to examine recently the masonry referred to by Mr. Clarke, built upon the line of the Erie Canal. This masonry was the retaining wall of the West Shore Railroad where it runs along the canal. Where it was first laid in very cold weather, without the proper use of salt, it gave way and got into very bad condition. Directions were then given, and carried out, for using a strong solution of salt for mixing the mortar, one barrel of brine being mixed when another was being used for mortar. The result has been very satisfactory, and the masonry is in excellent condition.

J. James R. Croes, replying to a question as to the use of salt, quoted from a paper presented by him in 1874 on the construction of a masonry dam: "In freezing weather the mortar was mixed with salt water. The rule for proportion of salt was one said to have been used in the works at Woolwich Arsenal some years ago, viz.: Dissolve 1 pound of rock salt in 18 gallons of water when the temperature is at 32° F., and add 3 ounces of salt for every 3° of lower temperature. The masonry laid with mortar thus prepared stood well and showed no signs of having been affected by the frost.

## How Shall Railroad Cars be Heated?

Mr. H. Q. Hawley, who has devoted much attention to the question of the employment of gas in domestic and industrial directions, thus discusses the heating of railroad cars:

Assuming that steam from the engine will be generally used, the matter most requiring to be tested for the solution of this problem is how to supplement steam from the engine for the time when it cannot be used, before the cars are connected with it, and when it is disabled away from terminal points. Why, then, are the tests now being made confined to the former use (requiring only a choice between several methods to find the best), while for the latter use nothing is done, although without providing for it the question cannot be settled?

As further proof of the necessity of extending the tests now being made, as above suggested, I add the following facts:

1. Relating to steam from stationary boilers: The advantage of this method is that it answers the purpose before steam from the engine is available. Its disadvantage is that it answers no other, and in answering that, requires, in case when (as at the New York terminus of the Pennsylvania road) several trains leave at the same time, or nearly so, that the track system be reorganized; and in all cases that new and costly investments shall be made at all stations when trains are made up and kept always ready for use.

2. Coal stoves and heaters, the means relied on at present for supplementary heating, are not practical for that use, as they require the fuel to be removed from them in a glowing state and after short use, and therefore are too wasteful, troublesome and dangerous for use at depots. When the engine breaks down, when a stove or heater is kept in a car for that contingency alone, there would be much delay in heating it up in time, and it would be filled with burning coal when the train began to move.

3. Assuming that neither of the methods above described for heating cars before steam from the engine is available for the purpose are practical, it follows that, so far as that operation is concerned, the car heating problem is narrowed down to the inquiry, "Can gas be used for it?" In answer to which, and as proof that I appreciate the conditions required to make the use of gas on cars practical, I here state them:

The furnace used for it must burn the gas without waste (as heat alone and not the impact of flame must be used) must be so arranged that any undiluted heat can enter its flues, as otherwise the cost of its operation would be too great. It must not require inconvenient alteration of the car. It must be supplied by gas pipes under the cars and connected between them, as steam pipes now are, so that when the gas used comes direct from street mains, all the furnaces in a train could be supplied from one connection with said main, turned on when the heating commenced, and off when the engine came.

It must not only heat the car, but be capable of heating it quickly when required for emergencies, or in extreme cold weather. And, if possible, the heater should be so constructed that it can be changed from a gas to a coal burner or back again in a few minutes and without other change than loosening a few screws, to provide for the contingency of the engine being disabled away from terminal points, and in cases when trains are made up when there is no gas. That is the case when gas is used only for heating—when it is used for both heat and light, of course, the gas in the storage tanks could be used, and the change to coal would not be needed.

Assuming that gas can be used as above stated, and the apparatus for its use so arranged that it can be taken directly from street mains while the cars are being heated up, and then shut off, so that only one heating with gas would be required for a route, however extended it may be, can any other method be safer, cheaper or more convenient? As neither storage tanks, under the cars, nor special gas works would be required, except at great cities and by trunk lines, when the use of gas, if used for both heat and light, would be so great that economy would demand its manufacture by private works.

Again, the use of mineral oils being now forbidden on cars, either gas or electricity must be used for lighting them, whatever means are used for heating them, so that the use of gas for both purposes is really the simplest method known.

I think that what I have written gives sufficient reason to show the neeessity of testing gas as well as steam without further delay.

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We believe the Penn Globe Lighting Co. has been authorized by the Gloucester City (N. J.) Council to light the streets with gasoline lamps.

## Utilization of Gas Tar.

Among recent English patents we note one that was granted to John Hammond, of Eastbourne, who proposes to utilize the tars produced in the manufacture of illuminating gas in accordance with a rather novel method. An abstract of the inventor's specification is appended :

The gas tar is continuously and automatically distilled, the light hydrocarbons going to enrich the coal gas, while the pitch or heavy hydrocarbons are drawn off to be burned or otherwise used. The drawings shown are intended to illustrate the manner in which it is proposed to practically apply the invention.

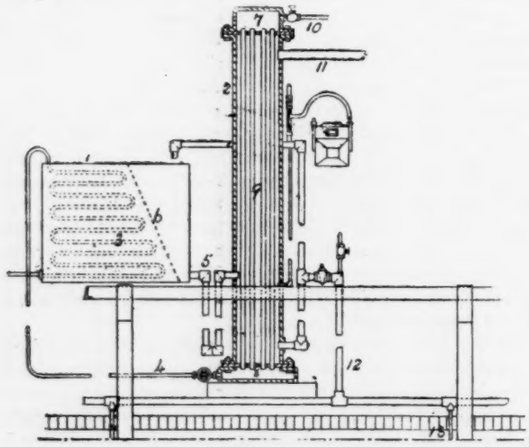

Fig. 1.

The tar is first placed in the tank, 1 (fig. 1), where it is heated by the waste heat from the still, 2, passing through the coil, 3, communication between the still and the coil being made by means of the pipe, shown at 4. From this tank the fluid tar gravitates to the still, 2, through the tube, 5. In passing from the tank, 1, it is filtered by the screen, 6, which is arranged so as to cause the arrested impurities to fall to the bottom of the tank, thus leaving the filter clear for the passage of the tar. The still, 2, is provided with chambers, 7 and 8, and tubes, 9, for the passage of high-pressure steam from the pipe, 10, to the pipe 4. The heat of this steam vaporizes the more volatile constituents of the tar in the still ; and these vapors are conducted by the pipe, 11, to a refrigerator constructed like the still shown by fig. 1. In this refrigerator the naphthaline, ammonia, and light oils from the still are condensed by the passage of water, air, brine or steam through the tubes. A pipe at the bottom of the refrigerator leads the condensed naphthaline and light oils back to the retorts to be again distilled with the gas, or into the hydraulic main to mix

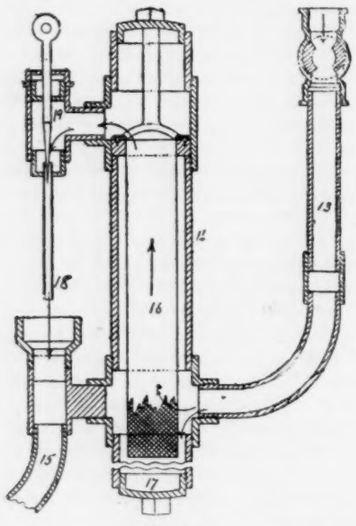

Fig. 2.

with the gas, or into a separate tank, the destination of the liquid being dependent upon the positions of certain stop-cocks upon the pipe. The heavy portions of the tar flow from the still, 2, through pipes, 12 and 13, to the fuel regulator, 14, placed at the side of the retort oven. From the regulator, 14, the tar is carried across to the furnace, in the center of the oven, by means of the pipe shown at 15.

Figure 2 shows the regulator in section. The coarser particles of tar held back by the cylindrical sieve, 16, collect in the lower part of the regulator, and are occasionally drawn off by means of the plug, 17. The sight-feed, 18, to the pipe, 15, is regulated by the needle, 19.

The tar flowing from the pipe, 15, falls into the tar channel, 20 (fig. 3), over the firebrick arch, 21, and thus reaches the incandescent coke at 22. The furnace is supplied with heated air through the flues, 23 and 24. The balanced ashpit damper, 25, regulates the passage of heated air to the lower flues ; 26 is an iron dead-plate, and 27 is a movable iron dead-plate. To keep up the temperature the various pipes are lagged with non-conducting material. A measured quantity of air heated to a temperature slightly above the temperature of the still is driven into the still by means of a steam jet to assist in the evolution of the light vapors ; a steam jet may also be used to agitate the boiling tar. To withstand the intense heat developed by tar firing the furnace may be lined with a mixture of oxide of magnesia and silicate of soda, with or without a small quantity of suitable fireclay. This mixture can also be used to stop cracks

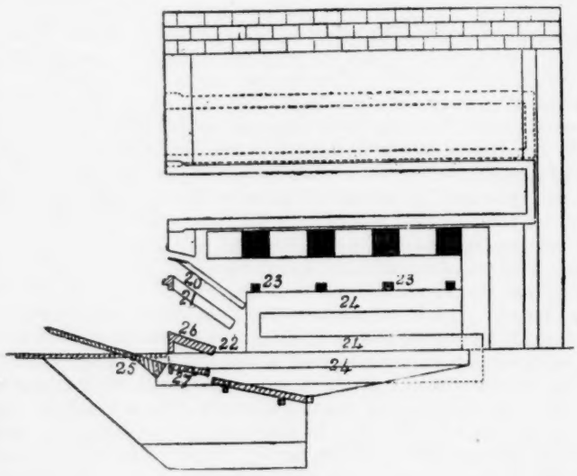

Fig. 3.

in leaky retorts ; and bricks formed of a similar material can be used to withstand the cutting action developed by too close tar firing when it is not convenient to enlarge the furnace to a more suitable size for the use of liquid fuel. The vapors from the still, 2, can be passed direct to the coal gas in the hydraulic main, without passing through the refrigerator, but when this is done it is necessary to pass the gas through a lime purifier either at the inlet or the outlet of the gasholder. The gas is made to pass from top to bottom of this purifier for the prevention of naphthaline crystals in the mains, etc.

## The Results of the Lighting Test at the Grand Central Railway Depot, Cincinnati, Ohio.

[Through the courtesy of Gen. Andrew Hickenlooper we are enabled to place before our readers the following summary of the report made by the experts—Messrs. J. W. Hill, M.E., Prof. Thos. French, Jr., of McMicken University, and C. E. Jones, Electrician—selected to determine the comparative cost and efficiency of gas and electricity in the lighting of the Cincinnati Grand Central Railway Depot. We preface the summary with a characteristic communication to the depot managers from the General] :

OFFICE OF CINCINNATI (O.) GAS LT. AND COKE CO.,
CINCINNATI, OHIO, Nov. 22, 1887.

To Jacob Heglin, Supt. Grand Central Depot : Dear Sir:—Jno. W. Hill, M.E., and Prof. Thos. French, Jr., of the Cincinnati University, the experts employed to test the comparative efficiency and economy of gas and electrical illumination of the depot under your charge, have submitted their reports ; but as they cover over 50 pages of closely written matter, tables, etc., I have concluded to transmit and ask you only to carefully consider the summary.

These tests show, and I have no doubt your personal observation will confirm the scientific test, that the gas illumination was much more brilliant and satisfactory than that afforded by incandescent lights ; and that at a saving of forty (40) per cent. ; that supposing their charge will hereafter be more moderate and proportionate to showing made under

this test, we can still give you the same degree of illumination for nearly twenty eight (28) per cent. less cost.

And this by the use of ordinary burners and fixtures placed in your depot at the time of its construction; since which time such advances have been made in the construction of regenerative burners that with the more approved form of such you can obtain three times the volume of light per foot of gas that could formerly be obtained through the use of ordinary burners.

In connection with this report permit me to call your special attention to the fact that, while the promoters of electric light enterprises assert that the expense of steam to operate the dynamos is merely nominal, this test confirms the correctness of former experiments, and conclusively proves that under the most favorable conditions it is over one-third the total cost.

And, finally, in order that there may be no mistake in the practical interpretation of the results of this test, I will now, on behalf of the directory of this Company, agree to enter into a contract, for any desired number of years, to light your entire premises with gas, and guarantee that the degree of illumination shall in no case be less than that now afforded by electricity, and charge for such service but $8,854 per annum, or *forty* (40) *per cent. less* than the incandescent lighting cost you last year. Very respectfully, A. HICKENLOOPER, Prest.

OFFICE OF JNO. W. HILL, MECHANICAL ENGINEER,
CINCINNATI, OHIO, Nov. 19, 1887.

General A. Hickenlooper, President Cincinnati Gas Light and Coke Company: Dear Sir:—I have the honor to submit herewith a complete detailed report of the results obtained from the recent test of the Edison electric light plant at the Grand Central Station, this city.

As the compilation of the results appear quite voluminous, and may prove a little tiresome to follow out in all its details, I thought best to submit with it this summary.

This test covered an interval of sixteen days; the first eight being assigned to the Gas Company, the second eight, of which I had special charge, from 6 A.M., Oct. 11, to 6 A.M., Oct. 19, or 192 consecutive hours, being devoted to the other side, both being carefully carried on.

During the whole of that time careful observations were made of the lights in service; the average illuminating power of the lights; the power required to produce the light, and the cost of its production.

During this test the steam used for operating the elevator pumps and for heating the buildings was taken from a separate set of boilers, leaving one battery to be used exclusively in furnishing steam to the engines used in driving the dynamos, and the cost of which was found to be as follows:

| | |
|---|---|
| *Coke* used (including fuel to start fires every two weeks) 929 bush., at 7 cents | $65.03 |
| *Water*, to boilers, including waste to sprinkle ashes and clean boilers, 38,408.16 gallons, which, at 9 cents per 1,000 gallons | 3.46 |
| *Wages*, two firemen—one day and one night—at $45 per month | 23.68 |
| Interest on investment and depreciation of boilers and fixtures | 9.86 |
| Total cost of steam supplied for eight days | $102.03 |

In order to ascertain the cost per annum it is necessary to determine the ratio of lighting hours which these eight days bear to the entire year; both the bills rendered for electric lighting and the lighting time-table of the Gas Company show the dark hours of October to be one-tenth of the entire year; which taken as the basis of calculation make the actual cost of steam for one year supplied by the Depot Company, $3,879.30.

*The charge for electric light*, exclusive of steam supply, is based upon the weight of zinc, in grammes, deposited during any interval of time, multiplied by the constant 17, gives the number of so-called "thousand-candle power" of light furnished for the interval, and for which they are, according to their contract, authorized to charge 45 cents per so-called "thousand-candle power" which charge is eqvivalent to $7.65 per gramme of zinc transferred during eight days. The weight of zinc thus deposited—as weighed and reported by the Electric Light Company—was 21,829-1,000 grammes, which at $7.65 per gramme, equals $167 for eight days, or $647.12 for month of October, or total cost per annum (exclusive of steam), $6,471.26.

*This discrepancy* between the cost, as shown by this test, and the previous *actual* charge made to the Depot Company, cannot be reconciled by any possible change of conditions, or any known method of computation, and certainly shows that either during this test some method was successfully adopted with a view of materially reducing the apparent cost of electricity, or that the charge heretofore made for an equal degree of illumination, has been disproportionate to the service rendered; for I am informed that for the month of October, 1886, the charge made was $926.06, and for the year, $10,784.82, making the *total expense for one year's electrical illumination* of the depot, *according to this test*, $10,350.55.

And, *according to actual amount* charged for 1886 by the Electric Light Company, $14,664.12.

The average illumination of all the lights in service at the depot buildings, train shed, omnibus court, along the tracks west of depot, and in the office and stables of the American Express Company, was equivalent to 185.15 lights of 16 *actual* candle power each, or 2962.4 candles.

Prof. French's test of the Cincinnati gas shows it to be 16.94-100-candle power.

An equal degree of illumination of gas—2962.4 candles—would require the use of ($16.94 \div 5 = 3.38$ candles per foot, $2962.4 \div 3.388 = 874.38$x24x8 days) 167,880.96, which, at $1.15 per thousand, equal $193.06.

Or, for October, $748.11; or, for one year, total expense, $7,481.10.

The total registered quantity of gas actually passing meters during the eight days' test was 214,700 cubic feet, of which 16,000 cubic feet (it is stated) was used by "thief lights" of old-style O'Neil lamps, leaving amount actually used for illuminating purposes, 196,700 feet, which, at $1.15, equals $228.50; for October, $885.44; or for one year, $8,854.40, thus showing:

*First*—That the same degree of illumination can be given with gas that was given by electricity, during the recent test, with a saving of $2,869.45, or 27.72 per cent. per annum.

*Second*—That using gas without limitation, affording a higher degree of illumination, the expense would be $5,809.72, or nearly 40 per cent. less than the actual cost of electrical illumination last year.

In the above estimate of cost of electricity—based on the transfer of zinc in the voltameters—it is assumed that the charge of the owners of the electric plant covers all the items of electricians' wages, interest, depreciation and profit on operation of plant, renewal of lamps, oil and waste for engines, and all other items of expense not otherwise specifically mentioned above.

Should this not be the case, but other items of expense of which I am unaware are borne by the Depot Company, then the cost and disparagement of the electric light becomes greater than I have shown it to be.

Apart from the cost of the light produced by the electric plant, there are other facts which have been pointed out in my general report, and to which I take the liberty of referring in this summary.

During the weighing of the zinc plates of the voltameters used by the Electric Light Company to measure the amount of light furnished to the Depot Company, the phenomenon (which I am informed is not unfrequent) was developed of the diminishing plate gaining instead of losing (as it should if the meter is working properly) in weight; showing an apparent reversal of current for meters Nos. 23, 24, 31, 32 and 39. The custom in cases of this kind being (as I am informed) to take the gain in weight of the plates—which should have lost in weight—as the measure of zinc transferred.

Although authorities on electrical science assert, with a given strength of current, the rate of transfer of zinc from one plate to another in a voltameter is constant for any given time, and knowing the time and current, the loss of zinc by the positive plate may be calculated from constants determined by experiment, it seems strange that the current should be reversed as it was in the meters noted above. And this fact of which we have ocular evidence, would indicate a state of affairs very dangerous to the pocket of the consumer of light. For if these meters will work backwards (as it were), why should they not work forwards at a rate greater than that assigned by theory, and cause a registration of more light than is actually furnished?

If I were a consumer of electric light I should require better evidence than that before me now to induce me to accept the record of these meters as a reliable statement of the light furnished.

Another fact to which I will again refer is the great range in candle power of the lights, with a slight change in the intensity or pressure of the electric current.

"Thus the (D) 32 nominal candle power lamp, with the filament placed at an angle of 45° to the plane of the photometer bar, with a resistance producing 99 volts, the current was 1.05 ampere, and the candle power 23.94; while with a resistance producing 99 volts the current was 1.268 ampere, and the candle power 42.89 or nearly twice as great as in the previous test."

The reduction of the resistance and current diminishes the load on the dynamos and engines, prolongs the life of the lamp, and materially diminishes the illuminating effect.

Should it appear that at any time during the day or night the voltage

(pressure) of the electric current is reduced below 99 volts, which I have reason (from our running record) to believe is the case, then the illumination produced will be greatly diminished from the standard, while the cost of the light to the consumer may be practically unchanged.

"From a comparison of currents required to maintain the test lamps it appears that the cost is about the same for a weak as for a strong light; or while the illuminating effect (candle power) of the light steadily diminishes with age (use) the current (ampere) to maintain its incandescency remains substantially constant.

"As a matter of fact it may be shown that the current, and consequently the cost to the consumer, becomes greater with a lower candle power; thus:

"*Thirty-two-candle Power Lamps.*

| Actual Candle Power. | Ampere. |
|---|---|
| 62.44 | 1.25 |
| 30.16 | 1.31 |

or, with a loss of illuminating effect of 50 per cent., the cost of the light is increased nearly 5 per cent., whence the relative cost of the weaker light is 217 per cent. of the stronger light.

"*Sixteen-candle Power Lamps.*

| Actual Candle Power. | Ampere. |
|---|---|
| 36.33 | 0.773 |
| 21.10 | 0.816 |

or, with a loss of illuminating effect of 52 per cent., the cost of the light is increased over 5½ per cent., whence the relative cost of the weaker light is 182 per cent. of the stronger light. Or, while the electrical energy was $1.25 \times 99 = 123.75$ Watts for the 62.44-candle power light, it was $1.31 \times 99 = 129.60$ Watts for the 30.10-candle power light; and while the electrical energy was $0.773 \times 99 = 76.527$ Watts for the 36.33-candle power light, it was $0.816 \times 99 = 80.784$ Watts for the 21.10-candle power light."

The power of the driving engines and the dynamos is usually stated in Watts, being the product of horse power of engines into the constant 746, or the product of the electric current (ampere) into its pressure or intensity (volts). Hence the more Watts required to maintain a lamp, the greater the cost of the light.

With gas or kerosene a given consumption of illuminating substance furnishes a constant power of light, while a diminished brilliancy of light is always accompanied by a reduction in the consumption of illuminating material, and a corresponding reduction of cost.

With the Edison light, however, it seems that a reduced brilliancy of lamp is not accompanied by a reduction of expense, but under certain conditions of lamps and service the cost may be actually greater for a light of 16-candle power than for one of twice the brilliancy.

Changing the position of the filament (loop) of the lamp, under same conditions of current and pressure, produces a reduction of 50 per cent. in the illuminating power.

The most startling result of this test to me is the loss of over 60 per cent. in effect between the driving engines and the lamps, or of every foot pound of work, or Watt, developed by the engines, less than 40 per cent. is actually realized in the illuminating power of the lamps. In any other application of steam power to useful work the relation of the work done to the power expended in doing it must come within 80 or 90 per cent. of the latter to satisfy demands for economy.

The tests of lamps for brilliancy were made by Prof. French, of the Cincinnati University, and the test for current required to maintain the lamps was made by Mr. C. E. Jones, electrician of this city, whose reports were submitted with my general report.

All of which is respectfully submitted. JOHN W. HILL.

## ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE Engineers' Club, of Philadelphia, Pa., will celebrate its Dicennial Anniversary to-morrow evening. A reception is to be held at the Club House, No. 1122 Girard street, whereat the caterer will ring the dinner bell at 9 P.M. Those who intend to attend may safely count on a most enjoyable evening.

PUBLIC LIGHTING, ELIZABETH, N. J.—The following proposals have been submitted to the City Council: Schuyler Electric Light Company, arc lights (1,000-candle power, nominal), at from $100 to $120 per annum each, according to hours of duty. Incandescent lamps (16-candle power), at $16.50 to $17.50 each per year, the latter figure to be paid in case the lights are to remain in duty from sunset to sunrise. The New York and New Jersey Globe Gas Light Company offered to renew its present contract (500 lamps), and agreed to fit up the posts with the Company's new and improved lantern (the lights to be extinguished at 1 A.M.), for $17 each per annum. If a 3 year contract was granted the price per post would be reduced to $16.50. If all-night lighting was determined on the lamps would be maintained on the basis of $18.75 for a single year and $18.25 for a 3-year contract. Every year that Elizabeth decides in favor of gasoline public lighting only serves to emphasize and advertise her poverty. Perhaps this unpleasant fact will finally come home to her rulers, ere their blindness will have put them beyond relief.

THE Norristown (Pa.) Gas Company has been making repairs to one of its gasholders, but seemingly to no avail. The task had been about completed—in fact, the vessel was being lowered into the tank when, through the breaking of a bolt, the holder tilted and a rather rapid and ruinous telescoping occurred. All the top rollers were wrenched off, three sheets were torn out, and the columns were badly strained. The masonry of the tank also suffered. Measures were at once taken to repair the damage, for the storage capacity of the holder is sadly needed by the Company just now.

THE Baxter Springs (Kansas) Coal and Gas Company has been organized by Messrs. R. A. Love, C. D. Meserve, H. R. Crowell, and others. Capital, $10,000. This place is on Spring River, and also on the Missouri River, Fort Scott and Gulf Railroad, at a point about 61 miles south of Fort Scott. Coal, lead and zinc are found in the vicinity.

PUBLIC LIGHTING, JACKSONVILLE, ILLS.—At a meeting of the City Council, held Dec. 1, a contract for the public lighting of the city was awarded to the Jacksonville Gas Light and Coke Company. The contract is to run for two years, and the Company agrees to perform the service for the sum of $5,500 per annum. Strange to say, Ald. Meany complimented the officers of the Company for "their universal courtesy toward the [Lighting] Committee, and their endeavor to please the city in its requirements."

FOR the week ending Dec. 6 the Gas Inspector (Prof. Aiken) of Baltimore, Md., reports that the gas supply continued to show uniformity in illuminating power much above the standard of 16-candles. He also reports that during the week 120 samples of oil were procured from dealers and tested. Of these 14 samples flashed at the standard temperature of 120° F., while 106 flashed above the standard, the range being between 123° to 130°.

HOW THE INSPECTOR EXPLAINED IT.—The last weekly report presented to the San Francisco Board of Supervisors by Gas Inspector E. P. McCarthy, concerning the illuminating value of the gases supplied by the different gas companies of the city, showed that the gas companies were keeping well up to the requirements of the statutes. This state of affairs did not appear to suit the nice discrimination of Supervisor Norton, who was unable to reconcile the Inspector's findings with the complaints made by the consumers. Having formulated the query, the Supervisor received a reply from the Inspector, who said the reason gas seemed to many to be so poor was because consumers were employing a newly-invented gas regulator, which, although it apparently saved them about 25 per cent. in their gas bills, also gave them a 50 per cent. poorer light. Turning off the spigot, but removing the bung—as it were.

KILLED BY THE CURRENT.—On the evening of December 4, Elmer E Wood, Manager of the Canandaigua (N. Y.) Electric Light Company, noticed that one of the street arc lamps was not burning properly, and sought to improve it by adjusting the carbons. The kid glove on his hand being wet transmitted the current to his body and he fell to the ground, dead. The only noticeable mark left on the corpse was a small hole, with blackened edges, in the right thumb.

CHEAPER GAS FOR BIG RAPIDS, MICH.—The proprietors of the Big Rapids Gas Company recently published the following notice: "On and after January 1, 1888, our discounts on gas bills will be changed as follows: Instead of a scale of discounts varying from 10 to 60 per cent. in proportion to the size of the bills over $2, as now in use, there will be a uniform discount of 60 per cent. on the even dollars of the amount of all monthly bills over $2, but no discounts will be allowed upon the first $2, or upon the odd cents of any bill, large or small. No discount whatever will be allowed to parties who fail to pay their bills on presentation, or within 10 days thereafter. At these rates bills of any amount under $3 will be net, and other bills will be as follows. For example, $3 gross would be $2.40 net; $4 gross or $2.80 net, and so on."

EXPLAINING A CHANGE.—In the course of a pleasant, chatty letter recently received by us from Mr. Geo. C. Hicks, President of the Chicago Retort and Firebrick Company, that gentleman thus explains the change which took place recently in the executive management of the Company:

"Our good friend Austin had to go to California, on account of his wife's health, this climate being too severe for her. Austin sold out his interest in the Company to Mr. C. A. Reed, an old friend of the writer. The change in the firm name was merely to reorganize, and have our office legalized in the Town of Lake, our former office having been in Chicago. We are enlarging our works and greatly increasing our facilities."

ANOTHER CHANGE.—Gerould's Improved Retort Cement is now being manufactured by C. L. Gerould & Co., with headquarters at Nos. 5 and 7 Skillman street, Brooklyn, N. Y., instead of at Manchester, N. H., as formerly.

CUPID'S CAPTURE AT AURORA, ILLS.—Mr. Wm. B. Miller, who was recently chosen Secretaay of the Aurora Gas Light Company, elected last Thanksgiving day as the proper date to pay a visit to Milwaukee, Wis. The records further show that he did not return home alone, because cards are now in circulation in Aurora which inform their recipients that Mr. and Mrs. W. B. Miller will be pleased to greet friends at their newly-chosen residence, No. 75 Holbrook street. The hymeneal knot was tied on Thanksgiving day, at the home of the bride's parents, Milwaukee, Wis. May their journey through life be happy and prosperous.

PUBLIC LIGHTING, RED BANK, N. J.—The Board of Commissioners for Red Bank have awarded a contract for the public lighting to the Red Bank Illuminating Company. The Company is to receive $1,300 per annum for 25 arc lights of the usual 2,000-candle power variety, and the contract is to last for three years. A moon-table is to be followed. The present cost of lighting the city by gas amounts to something less than $1,100 per annum.

LIMA (O.) COMPLAINS.—A correspondent says that trouble is brewing at Lima between the citizens and the Lima Natural Gas Company, the latter being a first cousin of the Standard Oil Company. The people say that the Company does not furnish the quantity of gas which it promised to supply in consideration of the payment of certain specified monthly sums. The Company was granted the right of way through the streets without being required to keep the pressure at any specific figure, and as nearly all the residences have gas laid on, the suppliers now refuse to keep up the pressure. The only consolation or comfort vouchsafed the complainants is obtained in the advice to pay more money and put in larger burners. To show that ground for complaint exists, our correspondent says that on one or two occasions the schools had to be closed because the heat was insufficient to keep the temperature of the classrooms at a point where the scholars would not suffer.

PUBLIC LIGHTING, CLEVELAND, OHIO.—The bids recently opened by the City Clerk show the following: The Brush Electric Light and Power Company offered, on a basis of 3,700 hours of lighting, to supply 4,000-candle power arcs for 10½ cents per hour each, or $3\frac{7}{10}$ cents per hour for 2,000-candle power lights. On a basis of 2,300 hours per year the bid prices were 13½ and 4.8 cents per hour respectively. The bid was accompanied by the proviso that the lights should be in the vicinity of the present system of wires operated by the Company. The Peoples Gas Light Company and the Cleveland Gas Light and Coke Company offered similar sets of figures. They proposed to furnish gas for $1 per thousand cubic feet; to light, extinguish and care for the lamps at $2.12 per year each; to remove or reconnect old posts for $3.50 each; to set new posts for $4 each, and to lay new service pipes for 15 cents per foot. Messrs. Harrison and Many offered the only bid for gasoline lighting. They agreed, on an annual lighting schedule of 3,760 hours, to maintain the lamps at a charge of $15.40 each, and propose to charge $1.25 each for the removal of posts. The bidders named are those who are now furnishing light to the city under the contracts about to expire.

DOWN GOES THE RAHWAY (N. J.) SCHEDULE.—Gas consumers in Rahway are to receive a New Year gift at the hands of Secretary Houston, who has been empowered to inform them that from and after 1st prox. gas is to be supplied at the net rate of $2 per thousand cubic feet. This concession is made from a gross charge of $2.50 per thousand, although those who consumed certain maximum quantities have hitherto been granted a discount. In his letter to us on the subject Secretary Houston, in referring to the abandonment of the discount feature, says the latter was always the cause "of much grief" to him because of that consumer who inevitably and invariably made his appearance one day too late, on the occasion of which visit the delinquent never could be convinced that such a slight lapse was of any consequence, always winding up his argument with the plea that his discount be granted "just for this time only." We hinted a fortnight ago that the Rahway Company's management was of the improving sort, and the above proves the hint.

MR. J. M. MURPHY has been appointed Western General Manager of the business of the Maryland Meter and Manufacturing Company. This appointment means that the entire Western business of the Company is under the direct supervision of a man thoroughly competent to care for it. Manager Murphy will also have complete control of the gas stove department, and he is quite likely to make a "success" of it.

MR. H. F. DOUT is to act as Engineer for a Company whose proprietors propose to construct and operate gas and electric light plants at various eligible points in the Argentine Republic and elsewhere. South American capitalists control the undertaking. It is intended to make the first venture in La Plata (or Chuquisaca), a city of Bolivia, a plant with a per diem capacity of 100,000 cubic feet having been arranged for.

TO GO INTO THE ELECTRIC LIGHTING BUSINESS.—The Directors of the Laclede (St. Louis, Mo.) Gas Light Company have determined to put in and operate an electric lighting plant of the most approved description. Both arc and incandescent lights will be furnished. It is somewhat amusing to note the kind of warfare now being waged against the Laclede Company in order to compel the latter to merge its individuality in the St. Louis Gas Trust. In fact the diaphanous nature of the combat is pronounced. As almost everyone knows the St. Louis Gas, Fuel and Power (or water gas) Company is now part and parcel of the old St. Louis Company, and under the terms of the famous "tripartite agreement"—the parties thereto being the city and the old St. Louis and Laclede Companies—it was determined that the latter Company should occupy the gas territory north of Washington avenue, while the former was to content itself with the southern portion of the city, the agreement to hold good until 1890. In the meanwhile the water gas speculators made a deal with the old St. Louis folks—the latter, by-the-way, getting much the worst of the bargain—and, when the Laclede Company refused to be grabbed, the water gas charter was availed of as a sort of club wherewith to bring the Laclede people to a comatose condition. In other words, the water gas tire of the Trust's wheel was turned in the direction of the "territory north of Washington avenue" and gas was sold there for $1 per thousand, while in the "territory south of the avenue" $1.50 was the ruling figure. And the other tripartite member—the city—looks calmly on, never saying a word. Some proof of the pudding is contained in the next "item."

ANNUAL ELECTION, ST. LOUIS (MO.) GAS COMPANY.—The following is from the St. Louis *Democrat*, of 6th inst.: "W. H. Thompson, President of the Gas Trust, controlled the election of Directors and officers of the St. Louis Gas Company yesterday. Of the 12,000 shares 11,554 were voted in the election for Directors, which took place in the morning, and Mr. Thompson voted 10,995 of these shares for the Trust. The four directors elected were David Rankin, jr., Peter Nicholson, Jno. R. Lionberger and Geo. T. Cram. Mr. Nicholson was the only one of the retiring directors who was re-elected, the three retiring ones being President Socrates Newman, Jno. Scullin, and Chas. Green. The new directors hold their offices for two years, and the five of the old board who remain in the directory—Messrs. W. H. Thompson, Chas. H. Turner, Thos. E. Tutt, Dwight Durkee and Geo. W. Fishback—will hold their offices one year longer. The new directors were selected at the last meeting of the Trust, and it was then decided also who the new officers should be. The new Board of Directors carried out the plans of the Trustees when the meeting for organization was held after the election. Mr. Thompson was elected President, Mr. Lionberger, President *pro tem.*, and Geo. M. Paschall was reappointed Secretary. The Board before adjournment adopted the following resolution: '*Resolved*. That the thanks of this Board are due and hereby tendered to Mr. Socrates Newman, ex-President of this Company, who has during the past ten years so zealously labored for its interests. While we regret that the present condition of his health compels him to retire from active connection with this Company, we hope at the same time that in seeking a much deserved and long needed rest he may be restored to his former robust health, and be enabled in the near future to resume his usual business relations with the community. In his retirement from active connection with the Company he carries with him the best wishes of the members of this Board, who will gladly welcome his return to renewed health and active business life.' Ex-President Newman intends to go South shortly to spend the winter, and if he returns to St. Louis next year with improved health it is likely that he will resume active connection with the several enterprises in which he is interested."

How the Strikers Fared.—Some of the helpers employed by the Norristown (Pa.) Gas Light Company thought they had Supt. Slingluff cornered immediately after the unfortunate accident which occurred to the gasholder that was being repaired, for in the midst of his added cares they coolly demanded an increase of 25 cents per day in their wages. They ought to have knowu Mr. Slingluff pretty well, since they had labored under him for some time—a kind employer we know him to be—but they must have been mistaken in their estimate He told them of the injustice and inopportunness of their demand, but they persisted—and got their discharge. The Company was not in any way inconvenienced by the strike.

Councilman C. W. Eager, one of the Committee appointed by the Manchester (N. H.) authorities to inquire into the advisability of the operation of an electric lighting plant by the city, recently asked for an extension of the period originally agreed upon as a limit to their researches. The request was granted; but it would seem to be good policy were the Committee discharged from any further consideration of the matter.

The Woodbridge (N. J.) *Sun* says that the Perth Amboy Gas Light Company is sending out an excellent quality of gas. Does that editor not place himself under suspicion as being a holder of Perth Amboy gas stock? Reflection, however, thrusts upon us the cold fact that editors, as a rule, are reasonably well off in this world's goods when they can proudly and truthfully boast of the possession of a well-made and staunch pair of suspenders.

Agreeing on the Price.—Some time ago we noted that the public lighting (hereafter to be electric) of Utica, N. Y., had been awarded to a new Company. As the contract with the Utica Electric and Gas Company—the gas portion of it, at least—expired on the 1st. inst., and as the new contractors would not be in readiness to go on with the work until Jan. 1, the City Council asked that the Gas Company continue its service to the public until the beginning of the new year. The Company agreed to supply the necessary gas at the rate of $1.60 per thousand.

The Carlisle (Pa.) Electric Light and Power Company has been organized. It is a very small affair.

The Saco (Me.) authorities some months ago awarded the public lighting to an electric company, but the proprietors of the latter were not in readiness to go on with the work when the Gas Company's contract ended. The interval was bridged over by the Gas Company, but when the latter presented a bill for the accommodation (it was only $296) the authorities thought the figure too steep, and the matter will occupy the attention of the Maine Supreme Court during the January term.

The estimate of $2,283 additional over the $14,000 appropriated for the maintenance of the gas and electric lighting of the White House and grounds, Washington, D. C., is to provide for an electric light tower in the ellipse south of the White House grounds. This section is commonly spoken of as the "White Lot."

In answer to many inquiries, it gives us great gratification to say that Mr. Jos. R. Thomas is rapidly recovering his normal physical condition.

Lowville, N. Y., at the last charter election, decided to light its streets with kerosene oil lamps. The sum of $500 was appropriated wherewith to carry on the work for a twelvemonth, but the powers that be now sorrowfully assert that the "appropriation was insufficient," instancing in proof that although the $500 had been absorbed on the 1st. inst., only 5 bbls. of kerosene remained in store. The contents of the "bbls." will be carefully husbanded, but we nevertheless feel that, despite the greatest care and caution, some of Lowville's nights will be "dark and dreary" between now and Feb. 29, 1888.

Morristown, N. J., appropriated only $3,500 wherewith to pay for the lighting during the fiscal year to end on May 1, 1888. The expense incurred in the six months ended Nov. 1 was something like 8 per cent. in excess of that which the appropriation would admit of. The 12 arc lights seem to be responsible in great part for the rapid diversion of the lighting fund. Morristown maintains 12 arcs, at $120 each per annum; 59 gas lamps, at $16 each; and 47 naphtha lamps, at 8½ cents each per night.

Reorganized.—At a recent meeting of the Knoxville (Tenn.) Electric Light Company the concern was completely reorganized. C. E. Dunstan, of Hartford, was elected President; J. P. McMullen, Vice-President, and D. J. Glazier, also of Hartford, Secretary and Treasurer. The owners propose to enlarge the plant so as to furnish incandescent lights. Knoxvillians do not seem to take kindly to the electric light.

What was Accomplished by Them.—We were somewhat surprised on receiving official notification that the Messrs. Tarbell (father and son) had retired from the service of the Waltham Gas Light Company, and we are yet at a loss to understand why such step was taken. Popularity and efficiency have marked them in their relations to the Company, and we are sorry that the change was made. We think Mr. Tarbell, Sr., became Superintendent of the Waltham plant about 10 years ago. At that time the annual output was not in excess of 6 millions cubic feet, the consumers numbering 400, and the leakage account was abnormally high—certainly not less than 30 per cent. of the total make—while $3 per thousand was the ruling selling price. At present the sendout is not less than 24 millions cubic feet per annum; the ledgers show the names of over 700 consumers; the unaccounted-for gas figures out at less than 5 per cent.; and the selling rate averages out at $1.92 per thousand. Ten years ago the works were in bad condition, while now they are in a complete and perfect condition. In fact, practically, they have been rebuilt. Two gasholders (aggregate capacity 165,000 cu. ft.) were erected. Of these one is arranged to take a second lift, when the necessities of business call for increased holder room, thus guaranteeing an additional 100,000 cu. ft. storage capacity at a comparatively trifling expense. Five miles of distributing mains were buried; the introduction of cooking and heating stoves was pushed with vigor; and the value of high-power gas burners was intelligently demonstrated. These things certainly prove that the Messrs. Tarbell kept abreast of the times. Within a year a 4-dynamo electric plant was installed, which was equal to the duty of supplying 100 arc and 400 incandescent lamps. Nor was the electric department of the business neglected, for the electric annex at the present time is sending out the equivalent of 70 arcs and 125 incandescents. The main offices of the Company, also, were located in handsome and commodious quarters on the Welch Block, right in the business center of the city. These facts and figures go to prove that the Tarbells can give a good account of their stewardship, and may rest content in the knowledge that the Waltham Company's interests did not suffer when their hand was on the helm.

The annual illumination at St. Louis, Mo., this fall was on a greater scale than ever, and was a thorough success, as usual. The total cost was $20,070.46. The number of gas jets burned is returned at 57,239, of which 29,863 were inclosed in colored globes. The item of breakage is quite an important one, this year's experience having cost the managers a loss of 7,784 globes. The annual illumination is now one of St. Louis's fixed events.

Gas Coal for the Philadelphia Works.—Director Wagner has awarded the following allotments to be made for supplying gas coal to the Philadelphia municipal gas works during the ensuing year. The bids were opened on December 6th:

| Contractor. | Tons Awarded. | Price per Ton. |
|---|---|---|
| Jas. Boyce | 35,000 | $3.79 |
| Despard Coal Company | 10,000 | 3.79 |
| Newburgh Orrel Coal and Coke Co. | 30,000 | 3.79 |
| Manor Coal Company | 10,000 | 3.83 |
| J. & W. Wood (gas coal) | 40,000 | 3.79 |
| " " (Hopetoun cannel). | 6,000 | 9.10 |
| Penn Coal Company | 84,500 | 3.84 |
| Westmoreland Coal Company | 84,500 | 3.84 |
| Total | 300,000 | |

It will be noted that the figures show an increase over the last awards of 10 cents per ton. Manufacturers might take notice that Philadelphia intends to put up 1,000 new gas posts and lamps, and 800 of the gasoline variety during 1888.

A certificate incorporating the Buffalo (N. Y.) Illuminating Company has been filed. The Trustees (D. E. Bailey, C. E. Clark, T. H. Meyer, Jr., H. R. Howland and E. G. S. Miller) set forth the purposes of the Company to be "the generation, manufacture and distribution of illuminants in the city of Buffalo." Buffalo, we thought, was pretty well provided for in this respect at the present time.

Virginia City (Nev.) is putting in an electric plant; and the Presque Isle (Me.) Electric Light Company has been incorporated.

The Ogdensburgh (N. Y.) Gas Light Company expects to supply electric light before the holidays. The initial capacity will be that from a 50-light dynamo.

It is not likely that the City Council of Cleveland, Ohio, will grant a franchise to those interested in the present movement for an opposition company. The argument made before the Lighting Committee of the Council, by Mr. J. H. Morley, President of the Cleveland Gas Light and Coke Company, was well adapted for the end in view. It was a decidedly telling argument.

The Brookline (Mass.) Gas Company has sent out a circular to the residents stating that it is prepared to supply them with incandescent electric lights, provided a sufficient number of subscribers can be found to guarantee a fair profit on the capital requisite to carry on the work. It is proposed to charge 2½ cents per hour of use for each 16-candle power incandescent light.

Jno. S. Hollingshead, a clerk in the employ of the Washington (D. C.) Gas Light Company, is an absconder. His cash is over $1,000 short.

People who are connected with the Austin (Texas) telephone exchange have reason to know and be fearful of the freaks occasionally traceable to contact between the exchange wires and those of the local Mather Electric Light Company. Perhaps the exchange itself has suffered the most, for the office switchboard and other paraphernalia of the establishment have been injured, in fact burned out, once or twice during the last month. The Mather Company operates respectively a Westinghouse incandescent and a Brush arc specimen.

The Buffalo (N. Y.) public lighting awards appear to have been made on the following basis: Arc lights (2,000-candle power) of the Brush, United States and Thomson-Houston types at the uniform rate of 47½ cents each per night. The three gas companies agree to supply gas, from and after Jan. 1, 1888, at the rate of $1.35 to the city, and $1.40 (net) to the public.

The Medina (N. Y.) Common Council has authorized the Thomson-Houston Company to maintain forty 2,000-candle power public arcs in that city for one year. The lights are to remain in duty 22 nights each month. Price, $62.50 each per annum.

The Coshocton (O.) Gas Light and Coke Company proposes to make its capital equal $31,000—an increase of $6,000.

The Edison Company now talks of attempting to sell plants to the gas companies, instead of establishing independent corporations, as heretofore.

Cheaper Gas for Holyoke, Mass.—Although the gas department of the Holyoke Water Power Company's business nominally figures as of secondary importance in its transactions, we nevertheless incline to the belief that, practically, Brother Snow's annual contribution to the Company's account in bank makes an imposing addition to the funds available for distribution in the shape of dividends among the fortunate holders of stock in that well-managed corporation. This year the Directors determined to grant the gas consumers a share in their prosperity—a plan adopted some years ago—for we note that Brother Snow is in the field announcing a reduction in rates, to take effect on and after Feb. 1, 1888. From that date ordinary consumers are to pay $1.75 net per thousand, while wholesale users will obtain their supply at $1.50. Very acceptable tidings for the holiday season, surely.

## The Conservation of Energy.

Mr. S. Dixon, at a meeting of the Manchester (England) Association of Engineers, presented a paper on the above-named topic. Having referred to a paper previously read by him before another meeting of the Society, and briefly summarizing the principles underlying the conservation of energy, Mr. Dixon proceeded to trace the amount of power available from the combustion of coal under given conditions. Beginning with boiler making, he said that an exhaustive series of experiments made by Mr. Michael Longridge, in 1884, demonstrated that the average efficiency of ordinary Lancashire boilers amounted to about 54 per cent. Comparing this with the effect obtained from the marine boiler, as shown by the paper recently communicated to the Institution of Mechanical Engineers, it was found to be a very inferior result, the efficiency of marine boilers having been there shown to be 80 per cent., the consumption of coal per horse power per hour being 1½ pounds.

The difficulty of ascertaining accurately what the engine was doing was one which pressed hardly upon anyone investigating the subject, as the data commonly related to the engine and boilers combined. In the report of Mr. Longridge, just referred to, however, an experiment made on a pair of compound engines indicating 900-h. p. showed that out of the total heat there was utilized about 12 per cent. The author then referred to the law of Carnot, and said that denoting the absolute temperature of the source of heat by T, and the absolute temperature of the condenser by $t$, the absolute efficiency is given by the well-known formula: $\frac{T-t}{T}$. Taking the case of the Corliss engines above referred to, the temperature of the steam entering was 309° F., and that of the ejection water, 106° F., from which, by applying the above formula, it is deduced that the efficiency of the engines is 26 per cent. The conversion of the whole of the heat into mechanical energy is only possible with a perfect engine, where the temperature of the condenser is absolute zero, but as this is impracticable all that can be done is to approach this point. Recurring to the case of the Corliss engines named, and comparing their efficiency with that of a perfect engine working between the same temperatures, the result is an efficiency of 41 per cent.

These engines were using 2 pounds of coal per h. p. per hour, but the averages over a number of engines, as given by one of the boiler associations, are as follows:

Compound engines, condensing, 3.66 pounds; single cylinder, condensing, 5.88 pounds; single cylinder, non-condensing, 7.95. Now, comparing these results with those of triple expansion marine engines, as recorded in the paper spoken of, they will be found to be very inferior. The author next referred to gas engines, and took the Otto as an example, observing that, up to the present, the economical results of this engine had not been surpassed. Taking an average of 20 cu. ft. of ordinary gas per hour as used by this engine, and calculating that each foot produces 620 units of heat, the total heat supplied to the engine would be 12,400, and as the units theoretically required for 1 h. p. are 2,564, it shows an efficiency of 20.6 per cent. Applying Carnot's principle, and calculating the efficiency of this engine as compared with a perfect engine working between the temperatures of combustion in the cylinder, viz., 3,000° F. and 1,250° F.—the assumed temperature of the discharged gases—the maximum efficiency would be 58 per cent., and it will be seen that an Otto works with an efficiency of 38 per cent. of that of the perfect engine.

An actual experiment established that 29 per cent. of the total heat was effective, the remaining portion being represented by 69 per cent. absorbed by the water jacket, and 2 per cent. from direct radiation. The amount of coal used per h. p. per hour by the Otto when Dowson gas is used is 1.3 pound; but it has been found that when the Dowson gas is produced from coke 1.4 pounds are needed per h. p. Turning now to the useful energy finally left after distribution, Mr. Dixon commented on the paucity of information at the command of investigators, saying that in the records of the insurance companies there must be a mass of valuable information as to the relative efficiency of various modes of communicating power. A gentleman of considerable experience, to whom the author had appealed, had, however, given him some details which showed that in mills using 800 to 1,000 h. p. it is found that the total energy absorbed by the friction of engines, shafting, etc., was from 20 to 30 per cent. of the whole power, sometimes reaching 35 per cent. Of the three main plans for driving, strap driving absorbs 5 per cent., and rope driving 10 per cent., more energy than spur gearing. Referring now to electricity, Mr. Dixon said that Sir Wm. Thomson had asserted that power could be transmitted three hundred miles with a loss of but 20 per cent.

An actual experiment made in Paris during last year established the fact that in transmitting 200 horse power 35 miles 50 per cent. was found to be lost. Even when we thus got the power into the factory or workshop, it would be found that an enormous waste of power was taking place in the operations of all machines, and that this required constant attention. The time lost in the use of machine tools was chiefly that required for setting, which was more than that occupied in cutting. The use of long chimneys was then referred to as a clumsy means of obtaining draught, and forced hot blast was advocated. Mr. Dixon then referred to some diagrams, stating graphically the results obtainable in a perfect engine, and those actually obtained, and showed that with an engine working with steam at a pressure of 200 pounds, and the heat in it finally reduced to a temperature of, say, 50° F., the realizable efficiency is only 40 per cent. Against this, Corliss engines are utilizing 14 per cent., and triple-expansion engines 15.9 per cent. The diagrams, which were constructed to scale starting at absolute zero of temperature, showed that the possible efficiency of gas engines was about 83 per cent. The use of a dynamometer in a convenient form was then recommended, in order to test the amount of power actually transmitted through a shaft or machine. The failure of the coal supplies of the country was then referred to, and it was pointed out that a great responsibility rested upon engineers to see that no power was wasted.

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,
PROPRIETORS.

Editor—JOS. R. THOMAS, C.E.
Asst. Editor—T. J. CUNNINGHAM
Manager—C. E. SANDERSON.

PUBLISHED ON THE 2ND AND 16TH OF EACH MONTH
At No. 42 Pine Street, New York.

This is a recognized official organ of—
LIGHT, HEAT, STEAM, WATER-SUPPLY,
VENTILATION, SANITARY IMPROVEMENT
AND GENERAL SCIENCE.

TERMS

SUBSCRIPTION—Three Dollars per annum, in advance.

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FRIDAY, DECEMBER 16, 1887.

## The Market for Gas Securities.

The market for city gas shares is again in the doldrums, but no substantial reason can be given for the existence of such a state of affairs. The output of the Consolidated Company is taxing its resources to the utmost, and amply proves the wisdom of its managers in their expenditures on plant account last spring and summer. The other city companies are also obtaining their share of business. The Brooklyn situation remains unchanged, and some demand for shares has stiffened the tone of the market. We note a sale at auction of 10 shares of Williamsburgh, at 112½. Washington (D. C.) gas is offered at 192½. The Baltimore deal, as far as consolidation is concerned, is off for the present, the Chesapeake Company having declined to scale its stock. The rate war, however, is not likely to be renewed just now. Chicago Trust stock is weak and strong by turns. Boston advices, per the remarks of the State Street News Bureau, say that the old Company offers to make 3 year contracts with those who consume $2,000 worth of gas annually on the basis of $1 per M.

The Bay State Company will hardly be ready to supply gas before April 1st, and if the old Company does not come to an understanding with its competitor before that date, the latter, we understand, will institute a 75 cent rate.

Noting all things connected with the gas supply of Boston, we fail to see how the Messrs. Greenough can be beaten in the contest for supremacy.

Montreal gas is considerably lower, 75 shares having changed hands last week at 191½.

Western shares, as a rule, hold their values, and the same may be said in a general way of approved southern securities.

## Gas Stocks.

**Quotations by Geo. W. Close, Broker and Dealer in Gas Stocks.**

16 WALL ST., NEW YORK CITY.

DECEMBER 16.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

| | Capital. | Par. | Bid | Asked |
|---|---|---|---|---|
| Consolidated | $35,430,000 | 100 | 70⅞ | — |
| Central | 440,000 | 50 | 30 | — |
| " Scrip | 220,000 | — | 47 | 57 |
| Equitable | 2,000,000 | 100 | 110 | — |
| " Bonds | 1,000,000 | — | 113 | 115 |
| Harlem, Bonds | 170,000 | — | — | — |
| Metropolitan, Bonds | 658,000 | — | 110 | 113 |
| Mutual | 3,500,000 | 100 | 90 | 93 |
| " Bonds | 1,500,000 | 1000 | 101 | — |
| Municipal, Bonds | 750,000 | | — | — |
| Northern | 125,000 | 50 | 30 | — |
| " Scrip | 108,000 | | | |
| Yonkers | | 50 | — | 80 |
| Richmond Co., S. I. | 300,000 | 50 | 50 | — |
| " Bonds | 12,000 | — | — | — |
| Gas Co's of Brooklyn. | | | | |
| Brooklyn | 2,000,000 | 25 | 100 | 103 |
| Citizens | 1,200,000 | 20 | 50 | — |
| " S. F. Bonds | 320,000 | 1000 | — | 103 |
| Fulton Municipal | 3,000,000 | 100 | 128 | 130 |
| " Bonds | 300,000 | | — | 105 |
| Peoples | 1,000,000 | 10 | 60 | 63 |
| " Bonds (5's) | 368,000 | — | 97 | — |
| " " (6's) | 94,000 | — | 100 | — |
| Metropolitan | 1,000,000 | 100 | 72 | 76 |
| Nassau | 1,000,000 | 25 | 90 | 95 |
| " Ctfs | 700,000 | 1000 | 95 | 100 |
| Williamsburgh | 1,000,000 | 50 | 110 | 115 |
| " Bonds | 1,000,000 | — | 111 | — |
| Out of Town Gas Companies. | | | | |
| Boston (Mass.) Gas Co | 2,500,000 | 500 | 220 | — |
| Buffalo Mutual, N. Y. | 750,000 | 100 | 90 | 95 |
| " Bonds | 200,000 | 1000 | 95 | 100 |
| Citizens, Newark | 1,000,000 | 50 | 140 | 145 |
| " " Bonds | 45,000 | — | — | — |
| Chicago Gas Trust | 25,000,000 | 100 | 38 | 38½ |
| Cincinnati G. & C. Co. | 6,000,000 | 100 | 178 | 180 |
| Consolidated, Balt. | 6,000,000 | 100 | 56⅛ | 56¼ |
| " Bonds | 3,600,000 | | 107 | 107½ |
| Chesapeake, Balt. | 1,000,000 | 100 | 86 | — |
| " | 1,000,000 | | 100 | 102 |
| Consumers Toronto | 1,000,000 | 50 | 192 | — |
| Central, S. F., Cal. | | | — | 84 |
| Capital, Sacramento, Cal. | | | 57½ | 60 |
| Hartford, Conn | 750,000 | 25 | — | 138 |
| Jersey City | 750,000 | 20 | — | 138 |
| Laclede, St. Louis, Mo. | 2,000,000 | 100 | 118 | 120 |
| Louisville, Ky. | 2,570,000 | 50 | 108 | 114 |
| Little Falls, N. Y. | 50,000 | 100 | 95 | 100 |
| " Bonds | 25,000 | — | 100 | 103 |

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